FREE-AIR SUMMARY FOR THE YEAR 1926

By L. T. SAMUELS

It is evident from Table 1 that free-air temperatures for the year, particularly in the lower levels, were mostly below their normal values. A general diminution of the departures with increase in altitude occurred in most cases, while a change to positive is found in the higher levels at Broken Arrow, Due West, Groesbeck, and Washington. It should be noted that the temperature departures for the naval air station at Washington are based on the Mount Weather, Va., records covering a five-year period (1907–1912). These have been omitted, however, below the 1,500 m. level on account of the great difference in elevation between these two stations and also because the Mount Weather data are based on the means of the ascents and descents of kite flights, whereas the airplane data represent ascents only. Above 1,500 m., however, there is probably very little difference due to either of these causes.

The persistence of a marked latitudinal normal temperature gradient to a considerable height above the surface is shown for the mid-western section of the country by a comparison of the Ellendale and Groesbeck data. It will be seen that the difference in the normal annual surface temperature between these two stations is 12.4° C., whereas at an altitude of 5,000 m. it is still 10.3° C., showing a net decrease of only 2.1° C. at this great height.

It is of interest also to note the longitudinal effect on the temperature gradient in the free air as shown by the records of Broken Arrow and Due West, these stations being almost on the same parallel of latitude. It is found that the normal annual surface temperature at Due West is 1.4° C. higher than at Broken Arrow, with the differences decreasing until a reversal takes place above 1,000 m. altitude, where Due West becomes the colder. The proximity of the ocean in this case would seem to be the paramount factor.

As would be expected with general negative temperature departures, the relative humidity was mostly above normal. Vapor pressures were below normal in the lower levels at all stations, but mostly above normal in the higher levels. (See Table 1.)

All previous minimum free-air temperature records for the month of September were broken at a number of stations on the 25th and 26th. On these dates the stations were under the influence of a strong high-pressure area and absolute minimum temperatures prevailed from the surface to altitudes reaching 4,000 m. at Ellendale. Similarly previous low-temperature records (particularly for the higher levels) for the month of January were broken at Drexel, Broken Arrow, and Royal Center on the 21st and 22d when a strong anticyclone passed over these stations.

Maximum free-air temperature records for July were exceeded for various levels at Royal Center, Ellendale, and Due West on the 18th–20th. During this period extremely high surface temperatures prevailed throughout these sections.

One of the outstanding aerological achievements of the year was a two-theodolite pilot-balloon observation made at Broken Arrow, Okla., on July 3. A 6-inch balloon was followed with both theodolites for 122 minutes and a practically uniform rate of ascent (190 m. p. m.) obtained during the first 100 minutes, at the end of which time the height was 19 km. During the last 22 minutes, however, the rate of ascent decreased considerably (averaging only about 90 m. p. m.) and the maximum height reached was 21 km. This observation was made in the southwest quadrant of a weak low-pressure area central over northwestern Missouri. The latitudinal surface temperature gradient over the country was extremely weak and therefore winds were light and favorable for such a long observation. A westerly wind prevailed from the surface to 3,500 m., where an abrupt veering to southeasterly occurred, the direction remaining so to the highest altitude. The wind velocity up to this height averaged only about 4 m. p. s. The balloon was finally eclipsed by Ci Cu clouds.

An unusual record of an exceptionally deep column of rapidly ascending air was obtained at Ellendale, N. Dak., on August 12 when a breakaway kite carrying the meteorograph rose abruptly from an altitude of 1,750 m. to 4,900 m. above the ground. The rate of the rising air current was approximately 10.5 m. p. s. For a detailed account of this observation see Free-air summary, MONTHLY WEATHER REVIEW, August, 1926.

During the following months the resultant wind movement was generally greater than normal:

February, March, April (particularly at northern stations) and August (particularly at Due West).

A general excess of north component in the resultant wind movement prevailed during March, June (particularly at Ellendale), July, November (particularly at Broken Arrow, Ellendale, and Groesbeck) and an excess of southerly component during August (particularly at Due West and Ellendale), September (particularly at Broken Arrow and Ellendale), October (particularly at Due West), and November (particularly at Due West and Royal Center).

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during the year 1926*

TEMPERATURE (° C.)

Altitude (m.) m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C.[1] (7 meters)	
	Mean	Departure from 9-yr. mean	Mean	Departure from 6-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 5-yr. mean
Surface	14.9	−0.7	16.5	−0.5	5.9	+0.2	17.6	−0.5	9.8	−1.3	10.9	-----
250	14.8	−0.7	16.2	−0.5	-----	-----	17.0	−0.5	9.6	−1.3	10.1	-----
500	13.6	−0.6	14.5	−0.4	5.6	0.0	15.8	−0.4	7.8	−1.2	9.4	-----
750	12.6	−0.6	13.2	−0.4	4.9	−0.2	14.9	−0.4	6.8	−1.0	8.5	-----
1,000	11.8	−0.5	12.0	−0.4	4.5	−0.2	14.2	−0.4	6.0	−0.8	7.5	-----
1,250	11.0	−0.4	10.7	−0.5	4.0	−0.2	13.4	−0.4	5.2	−0.6	6.4	-----
1,500	10.2	−0.2	9.5	−0.5	3.3	−0.1	12.6	−0.3	4.2	−0.6	5.4	−0.8
2,000	8.1	0.0	7.1	−0.5	1.1	−0.2	10.4	−0.4	2.2	−0.5	3.7	−0.3
2,500	5.5	+0.1	4.7	−0.4	−1.5	−0.2	8.1	−0.3	−0.2	−0.6	1.6	−0.1
3,000	2.8	+0.2	2.3	−0.3	−4.4	−0.3	5.5	−0.4	−2.7	−0.5	−0.9	+0.1
3,500	0.0	+0.2	−0.5	−0.4	−7.4	−0.5	2.4	−0.8	−5.1	−0.3	−3.8	+0.2
4,000	−2.9	+0.2	−3.6	−0.5	−10.6	−0.9	−0.1	−0.5	−7.7	−0.4	−6.2	+0.8
4,500	−5.6	+0.3	−6.3	−0.2	−13.8	−1.2	−2.3	0.0	−10.1	−0.2	−9.4	+0.8
5,000	−8.3	+0.4	−8.1	+1.0	−16.0	−0.6	−3.8	+1.3	-----	-----	−12.0	+1.3

RELATIVE HUMIDITY (%)

Surface	68	0	66	+1	69	−3	74	+1	72	+2	75	-----
250	68	0	66	+1	-----	-----	73	+1	72	+2	73	-----
500	66	+1	65	+1	68	−3	72	+2	72	+3	69	-----
750	64	+1	65	+1	65	−2	70	+3	71	+3	68	-----
1,000	62	+1	64	0	62	−2	66	+3	69	+3	67	-----
1,250	58	−1	63	0	60	−1	62	+3	67	+3	67	-----
1,500	55	−2	61	−1	59	−1	58	+2	66	+4	67	-----
2,000	50	−3	58	−1	56	−1	53	+3	61	+4	65	-----
2,500	46	−4	54	−2	54	−2	49	+3	58	+4	63	-----
3,000	45	−3	51	−2	54	−1	47	+4	54	+2	61	-----
3,500	44	−4	50	−1	55	+1	45	+4	51	+1	59	-----
4,000	43	−4	54	+3	57	+4	45	+5	55	+7	57	-----
4,500	41	−4	53	+3	58	+5	43	+6	59	+10	51	-----
5,000	46	0	44	−5	54	+3	58	+21	-----	-----	51	-----

[1] Naval air station.
[2] Based on observations made at Mount Weather, Va., July 1, 1907–June 30, 1912.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during the year 1926*—Continued

VAPOR PRESSURE (*mb.*)

Altitude (*m.*) m. s. l.	Broken Arrow, Okla. (233 meters)		Due West, S. C. (217 meters)		Ellendale, N. Dak. (444 meters)		Groesbeck, Tex. (141 meters)		Royal Center, Ind. (225 meters)		Washington, D. C. (7 meters)	
	Mean	Departure from 9-yr. mean	Mean	Departure from 6-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 9-yr. mean	Mean	Departure from 5-yr. mean
Surface	13.42	−0.29	13.84	−0.07	7.65	−0.47	16.54	−0.18	10.50	−0.33	12.16	------
250	13.32	−0.28	13.63	−0.06	------	------	15.92	−0.17	10.38	−0.29	11.24	------
500	12.10	−0.03	12.24	−0.02	7.41	−0.50	14.54	−0.05	9.28	−0.09	10.13	------
750	11.00	+0.07	11.25	0.00	6.63	−0.43	13.20	+0.09	8.56	+0.15	9.30	------
1,000	10.06	+0.12	10.39	+0.02	6.12	−0.31	11.80	+0.21	7.92	+0.25	8.50	------
1,250	8.99	+0.01	9.45	−0.01	5.59	−0.26	10.27	+0.02	7.28	+0.34	7.84	------
1,500	8.00	−0.04	8.45	−0.08	5.10	−0.20	8.88	−0.25	6.59	+0.38	7.25	------
2,000	6.27	+0.01	6.73	−0.08	4.22	−0.11	6.97	−0.16	5.29	+0.41	6.14	------
2,500	4.88	−0.01	5.23	−0.16	3.49	−0.05	5.60	−0.10	4.16	+0.45	4.98	------
3,000	3.96	+0.11	4.26	−0.01	2.86	+0.02	4.54	−0.05	3.28	+0.42	3.89	------
3,500	3.22	+0.14	3.48	+0.05	2.38	+0.10	3.63	−0.09	2.64	+0.45	2.90	------
4,000	2.70	+0.29	3.03	+0.21	1.87	+0.03	3.25	+0.19	2.44	+0.81	2.08	------
4,500	2.27	+0.40	2.32	+0.01	1.40	−0.10	2.63	−0.04	2.40	+1.08	1.42	------
5,000	1.91	+0.38	1.26	+0.71	0.74	−0.57	2.70	+0.28	------	------	1.02	------

THE WEATHER ELEMENTS

By P. C. DAY, In Charge of Division

PRESSURE AND WINDS

There were few conditions that marked the weather as distinctive from that of an average winter month, though changes were frequent and important, as may be expected in the first month of winter.

Important cyclones were notably absent during the first decade, although there were some local heavy rains on the 2d and 3d in northern California and portions of the far Northwest and in southwestern Arizona on the 4th and 5th and again on the 10th; in fact rain was almost of daily occurrence from the 4th to 14th over much of the State, and in the vicinity of Yuma the local fall was far above the normal for the month and nearly twice as much as in any previous December of record.

During about the same period as referred to above there was rather widely scattered precipitation in the southern Plains, and thence east and northeast, some heavy falls occurring in northern Texas and near-by areas on the 6th and 7th and in southern Texas on the 10th.

A cyclone with marked barometric depression moved into the upper Missouri Valley on the 11th and thence rapidly advanced southward to Colorado during the following 24 hours, attended by some of the lowest pressures ever observed during December in that region. This storm merged with another moving in the same direction somewhat farther east, and curved sharply to the northeast during the afternoon and night of the 12th and on the morning of the 13th was central over the upper Lakes, moving thence to northward of the St. Lawrence Valley during the following day. Despite the low pressures in the early life of this cyclone it was not attended by important precipitation except far south of its center, in Tennessee and near-by sections, where local heavy rains occurred on the 13th and again on the 14th.

No extensive cyclonic disturbances occurred during the latter part of the second decade, but on the 20th pressure was low over the Southwest, and by the morning of the 21st the center of a moderate cyclone was over Arkansas and heavy rains had fallen over large areas in that and near-by States. At Little Rock a total fall of nearly 6 inches occurred within 24 hours on the 20th and 21st, and amounts nearly as large were reported from points in near-by States. As this storm moved northeastward toward the Middle Atlantic States local heavy rains occurred during the 22d.

Another cyclone moving from the southern Plains northeastward to the Great Lakes on the 23d and 24th again brought local heavy rains over much of the area covered by that of a few days previous. This was quickly followed by still another low-pressure area that moved from southern Texas northeastward, again causing heavy precipitation over much of the area visited by previous storms, but including much of the country to the eastward, though here the precipitation was mainly not so heavy.

By the morning of the 28th cyclonic conditions had overspread the lower Mississippi Valley and local heavy rains were again falling in that region, extending during the following 24 hours to all districts east and northeast, heavy rains falling in the Atlantic States with more or less snow in the Lake region, upper Ohio Valley, and to the northeast.

Anticyclones dominated the weather in the Plateau and in northern and central districts. One of the most important of these entered the upper Missouri Valley on the morning of the 13th and, drifting slowly southeastward, favored cold and fair weather over most central and eastern districts until the end of the second decade.

An extensive anticyclone covered the far Northwest on the 23d and by the following morning was centrally located over the middle Plateau, whence it drifted south and east during the following few days, but lost intensity as it approached the Atlantic coast.

By the 27th an anticyclone had overspread the California coast and moving into the middle Plateau dominated the weather from the Rocky Mountains westward until the close of the month.

Except in a few instances barometric gradients were not unusual, and hence wind velocities were not high or extensive; only in local areas was there damaging wind.

The prevailing directions were marked by unusual differences at neighboring stations and no important areas had prevailing winds uniformly from a single direction. Details concerning damage by winds or other storms appear at the end of this section.

TEMPERATURE

December again showed a tendency toward above-normal temperatures over the far western districts, as in practically all the preceding months, while in the Great Lakes region and to the eastward a tendency toward lower than normal temperatures, which has persisted since February, was again rather marked.

As a whole the month had frequent changes in temperature and numerous comparatively brief cold waves moved across the northern and central districts from the Rocky Mountains eastward; no unusual cold was experienced over extensive areas.

The first week was decidedly cold over northern districts from the Rocky Mountains eastward, but mainly warmer than normal in the South and far West, the week being unusually warm in the middle Rocky Mountain and Plateau regions. The second week continued decidedly warmer than normal in the Southeast and moderately so in the Southwest, but there was a change to moderate cold in the far Northwest, and it continued cold in northern and central districts eastward as far as the Great Plains, and in the extreme Northeast.